

FAA's Aircraft Fire Safety R&D Program: *Recent Major Accomplishments and General Activities*

Gus Sarkos

Fire Safety Branch

FAA Wm. J. Hughes Technical Center

Atlantic City Airport, NJ

NIST 2007 Annual Fire Conference

April 4 – 5, 2007

Gaithersburg, MD

Aircraft Fire Safety: Areas of Concern

Postcrash Fires



In-flight Fires



Major Accomplishments

- Improved Fire Test Methods and Criteria for Thermal Acoustic Insulation (In-Flight and Postcrash)
- On-Board Fuel Tank Inerting System to Prevent Fuel Vapor Explosions

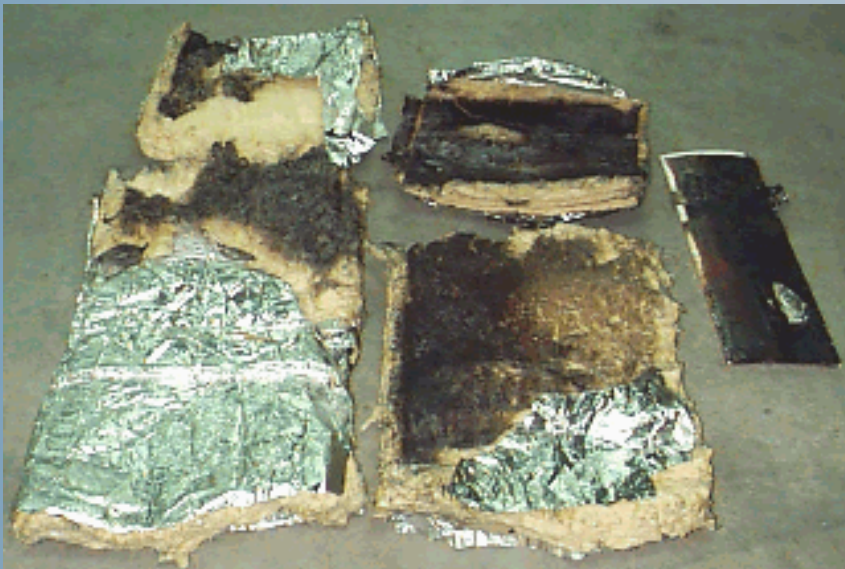
Swiss Air

McDonnell Douglas MD-11; September 2, 1998



American MD-80

Dulles Airport; November 29, 2000



Insulation Blankets



Metallized Mylar



Metallized Tedlar



Plain Mylar



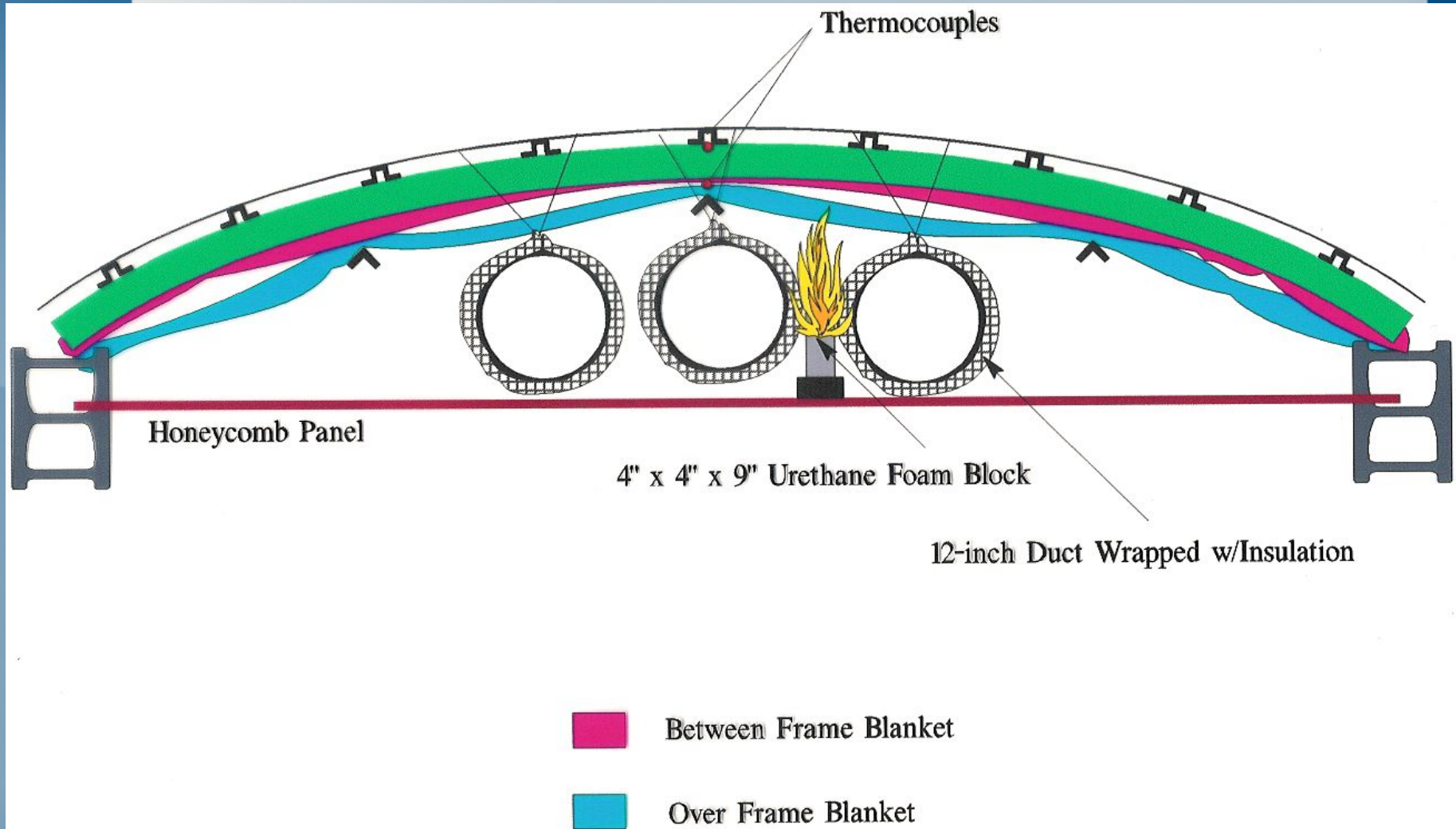
**Insulation Blanket with
Polyimide Film Cover**

Thermal Acoustic Insulation

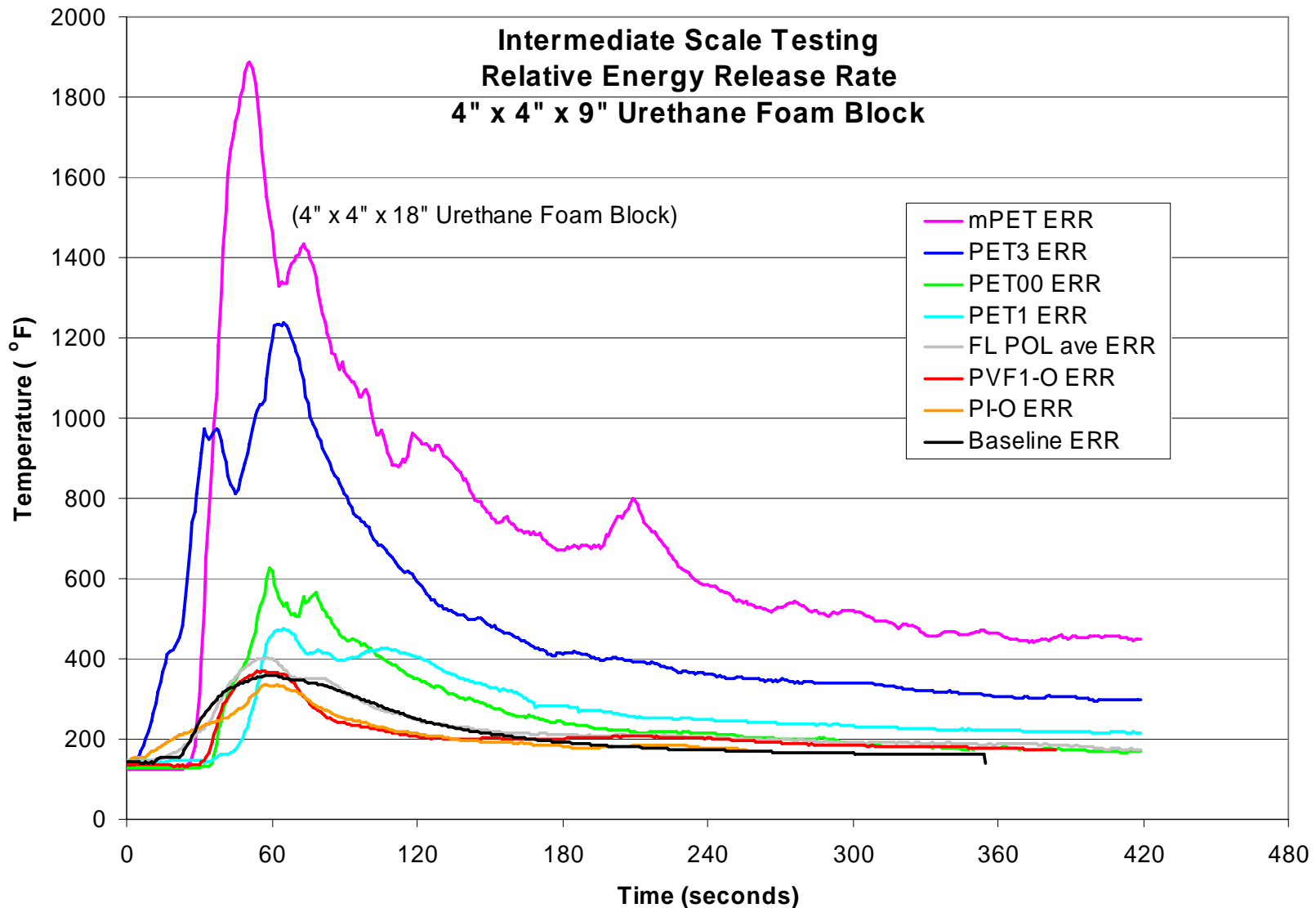
Areas of Concern

- In-Flight Fire Ignition and Flame Spread Resistance
- Postcrash Fuel Fire Fuselage Burnthrough Resistance

Large-Scale Test Configuration for Measuring Flammability of Insulation Blankets

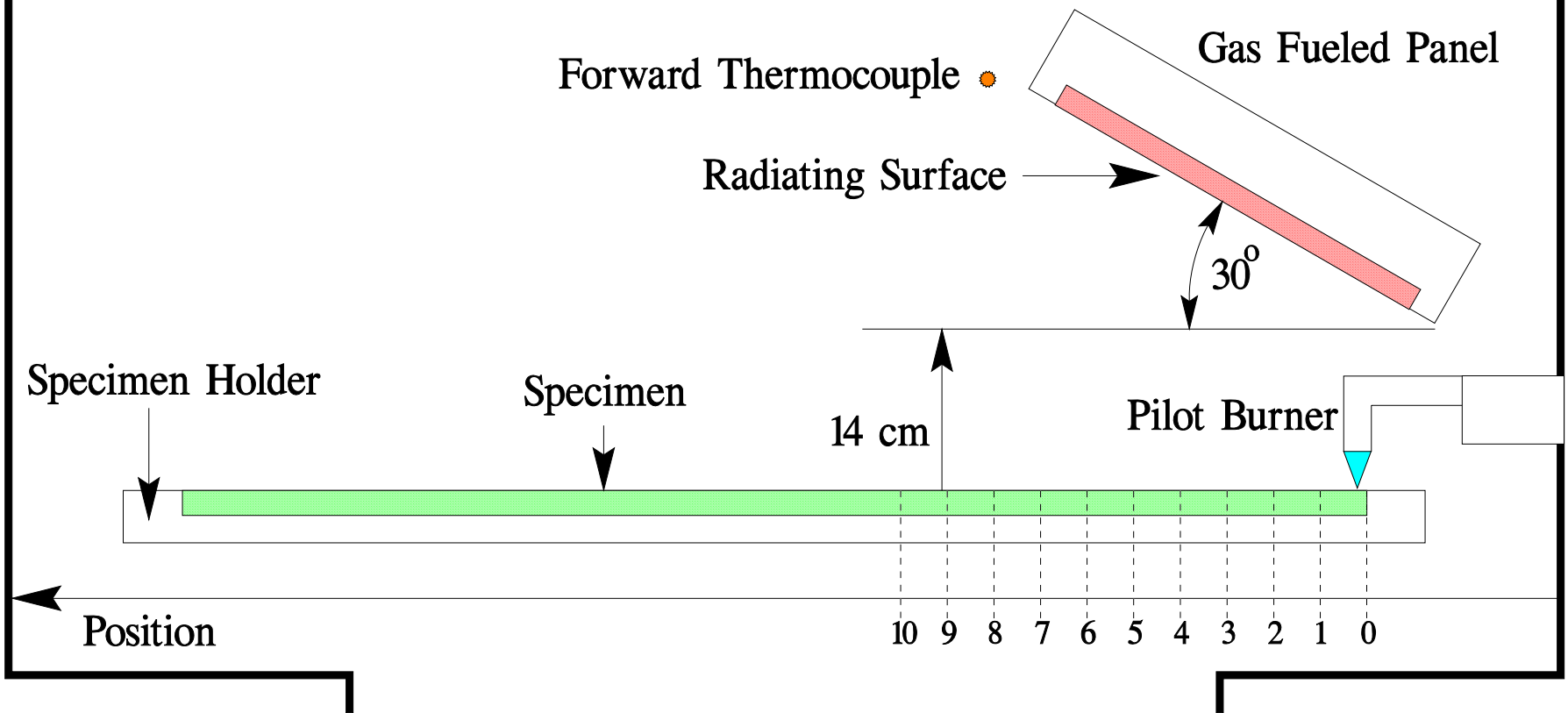


Temperature Profiles of Various Film Materials



Schematic of Radiant Panel Test Apparatus

- Chimney Thermocouple
- Middle Thermocouple



Results of Radiant Panel Test Using Various Film Materials

Films Tested With 0.34 lb/ft ³ Fiberglass	Supplier Product Designation	Mass per Area (g/m ²)	Burn Length (inches)	Burn Length (inches)	Burn Length (inches)	Burn Length Average (inches)	Critical Heat Flux (kW/m ²)
Polyethylene teraphthalates							
PET00_L	8273	18.0	13.0	15.0	11.0	13.0	12.0
PET00_0	Orcofilm AN-36W	17.8	15.0	12.0	16.0	14.3	10.5
PET1_L	8234	29.6	24.5	25.0	24.5	24.7	7.5
PET1_F	Insulfab 240	30.1	21.0	20.0	22.0	21.0	7.5
PET1_O(R)	Orcofilm AN-47R	27.2	TC	TC	TC	TC	<4
PET1_O(W)	Orcofilm AN-47W	30.4	19.0	17.0	21.0	19.0	8.5
PET2_L	8271	43.1	27.5	26.5	24.5	26.2	7.0
PET3_L	8272	57.5	28.0	22.5	19.5	23.3	7.3
PET3_F	Insulfab 260	54.6	30.5	34.5	35.0	33.3	5.2
MPET1_F	Insulfab 350	32.8	TC	TC	TC	TC	<4
Polyvinyl fluorides							
MPVF1_O	Orcofilm AN-18R	32.8	14.5	17.0	15.5	15.7	10.0
MPVF2_F	Insulfab 330	44.1	NFP	NFP	NFP	NFP	>18
PVF2_J	Terul 14	47.6	19.0	22.0	24.0	21.7	8.5
PVF2_J	Terul 9 Lab 13H	45.5	NFP	NFP	NFP	NFP	>18
Polyimides							
PI_F	Apical 100JL	65.5	NFP	NFP	NFP	NFP	>18
PI_O	Orcofilm KN-80	52.2	NFP	NFP	NFP	NFP	>18
PI_L	10313	49.5	NFP	NFP	NFP	NFP	>18
PI_J	Terimide9 Lab06E	52.5	NFP	NFP	NFP	NFP	>18
Others							
INS2000_F	Insulfab 2000	103.8	NFP	NFP	NFP	NFP	>18
FPC3_C	Chemfilm	61.0	NFP	NFP	NFP	NFP	>18

FPC = Fluoropolymer Composite

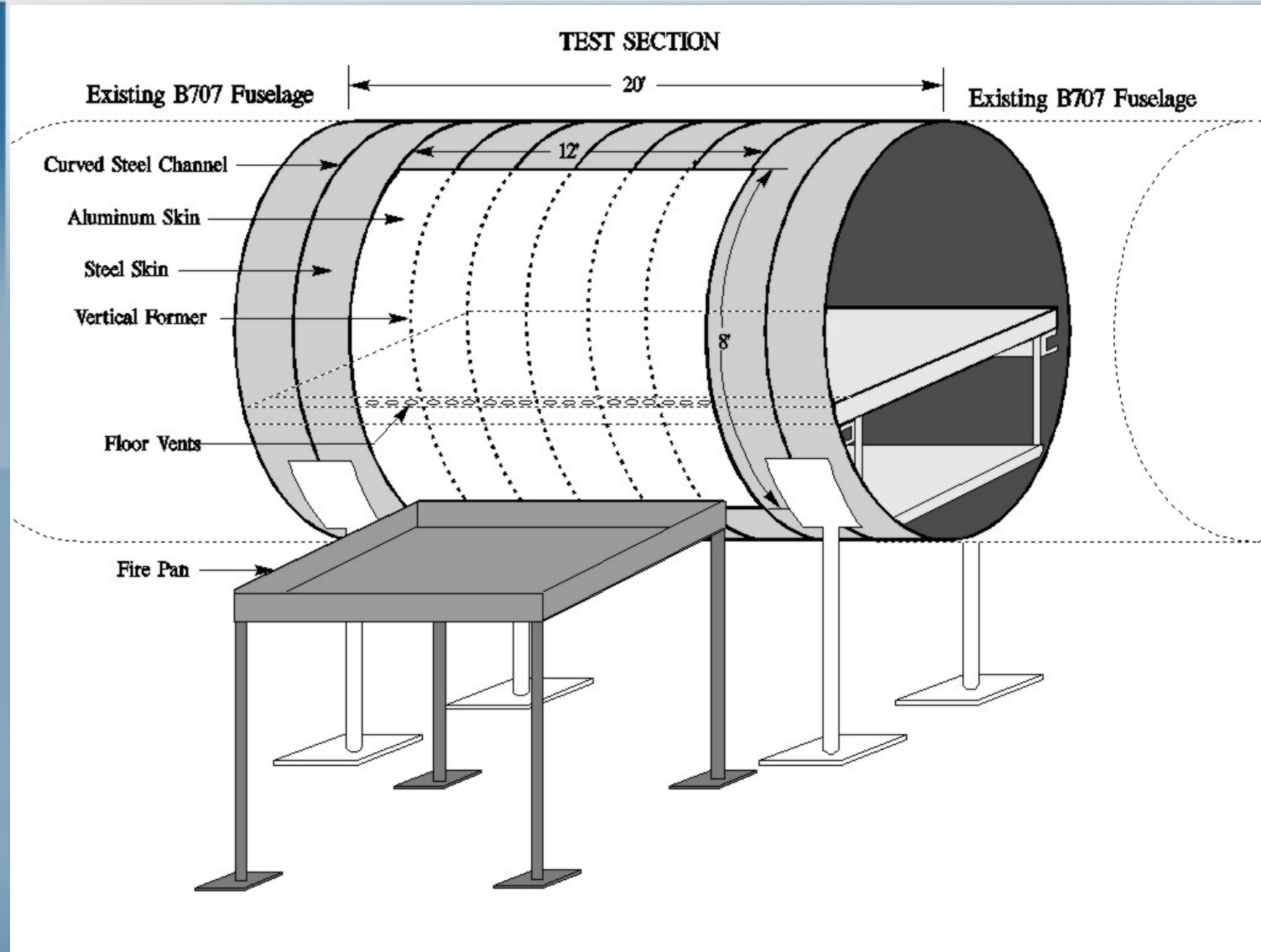
TC = Totally Consumed

NFP = No Flame Propagation

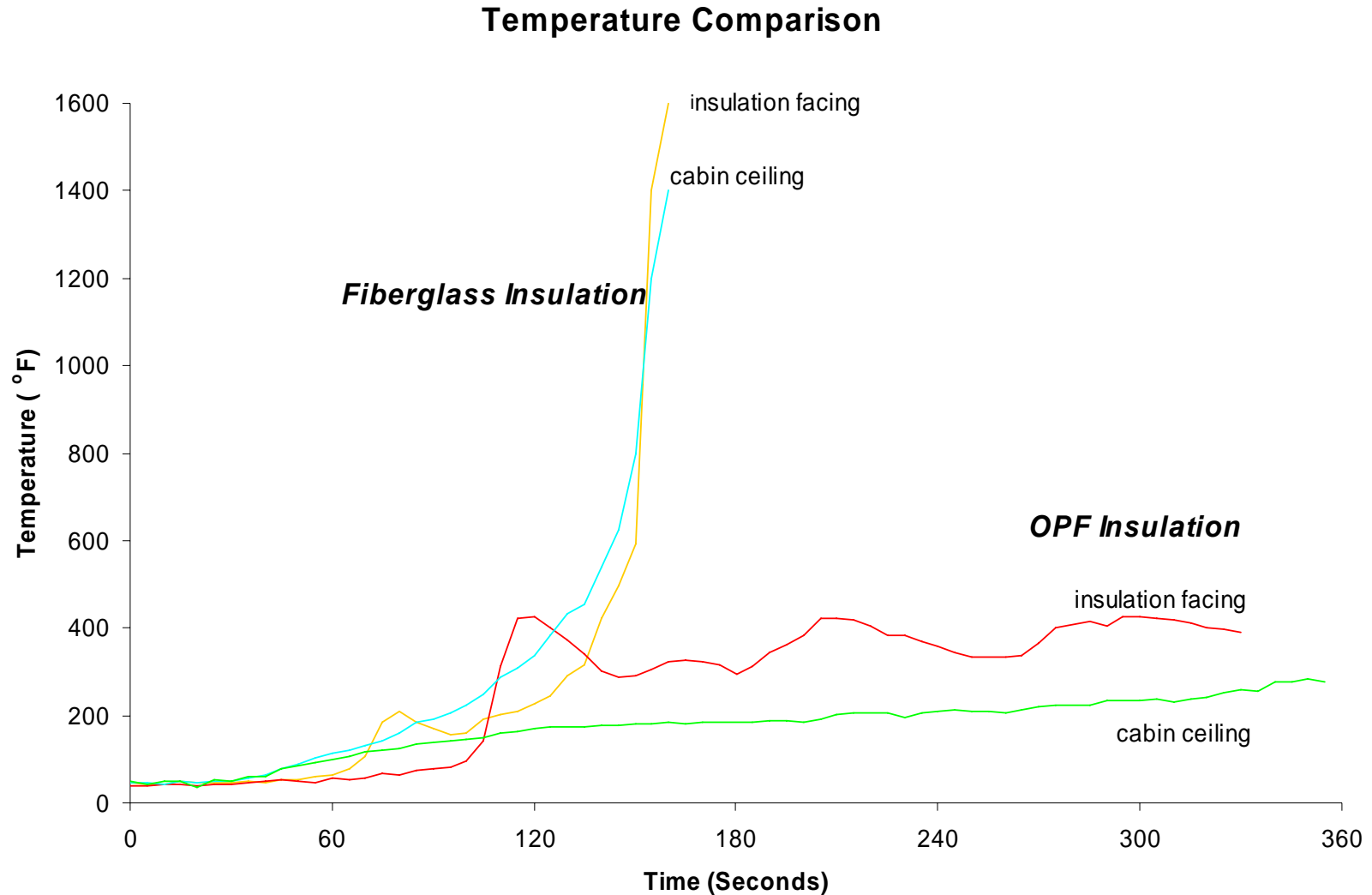
Postcrash Fire Burnthrough Resistance



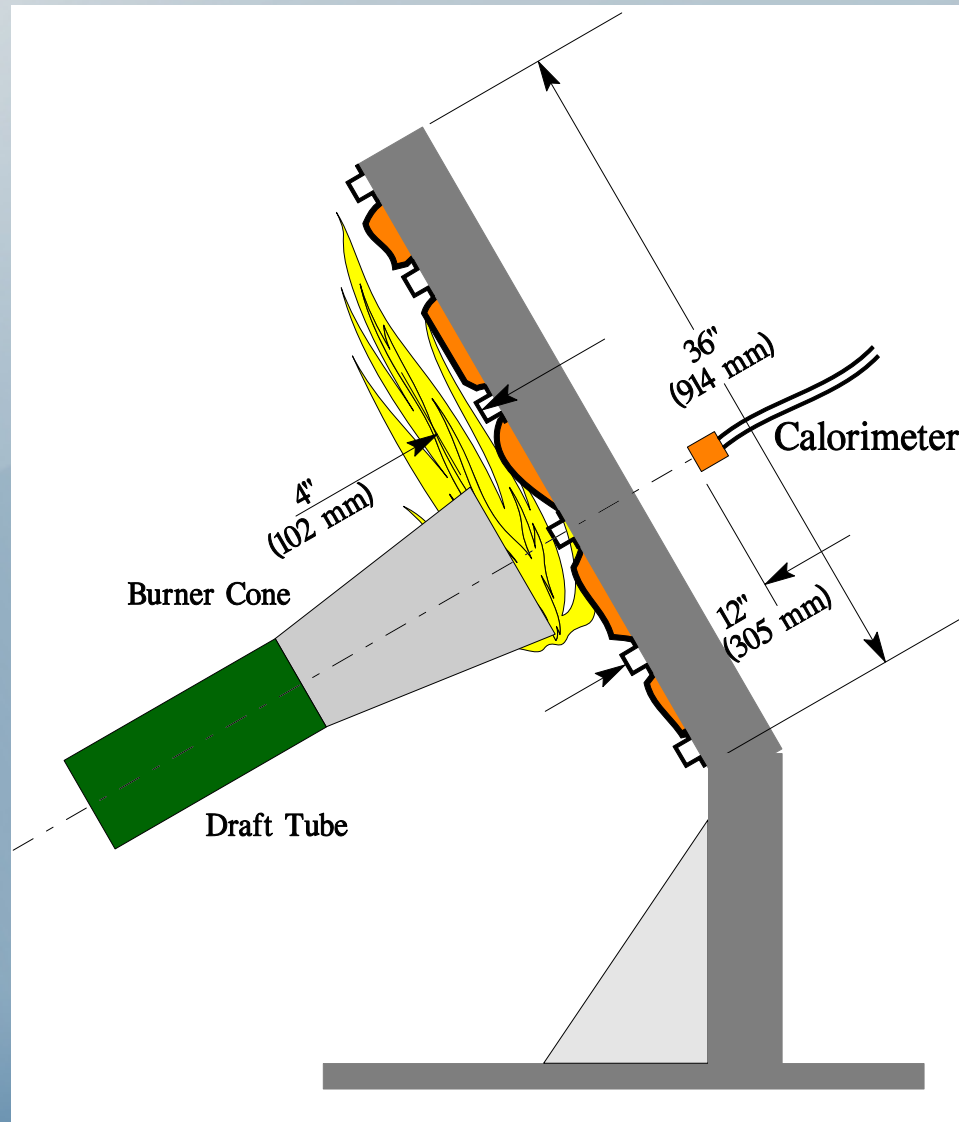
Full-Scale Burnthrough Test Rig Positioned in Aft B707 Fuselage



Temperature Comparison of Current and Alternative Materials

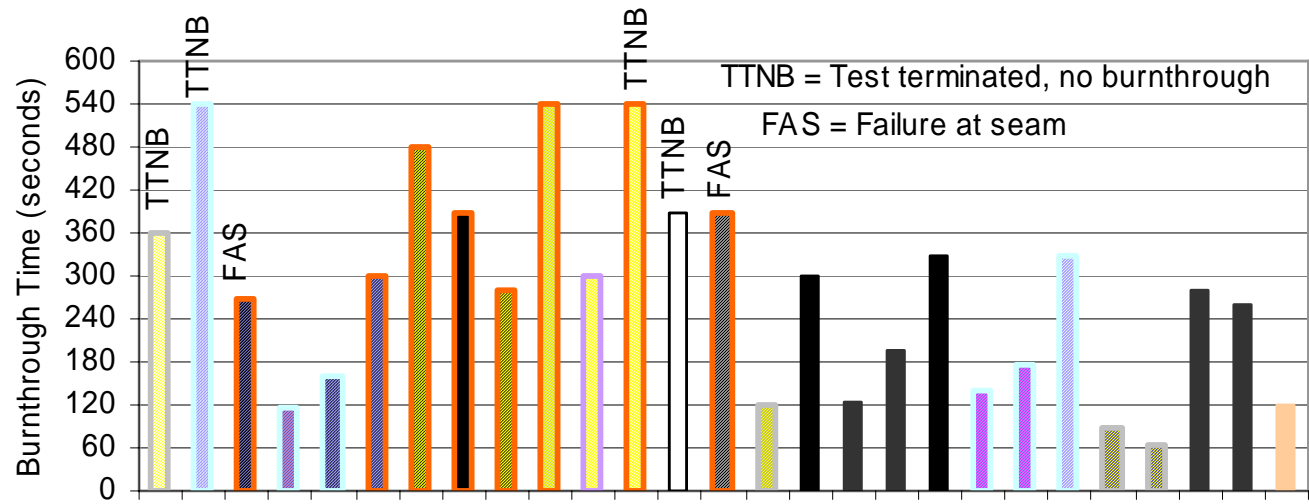


Burnthrough Test Apparatus



Test Results Using Various Material Combinations

Burnthrough Test Comparison Using 6 GPH Burner @ 4 Inches from Insulation



2 ply 0.42 lb/ft³ FG/Ceramic paper/me...
 2 ply 0.34 lb/ft³ FG+Polyimide Foam+0...
 3 ply 0.34 lb/ft³ FG+Panox mat/PET film
 1 ply 5250G OPF+2 ply 0.42 lb/ft³ FG/PI..
 1 ply OPF+2 ply 0.42 lb/ft³ FG/PI Film
 2 ply 0.42 lb/ft³ FG+0.125-inch needl..
 1 layer Ceramic paper/no film
 2 ply 0.42 lb/ft³ FG+Carbon Fiber scri...
 1 ply Carbon Wool (DLW-1025B)/No Film
 2 ply FR treated FG mat+3 ply 0.34 lb/...
 2 ply 0.42 lb/ft³ FG+Carbon Fiber scri...
 2 ply carbon felt
 2 ply Basalt fabric

Airworthiness Directive

- Adopted May 26, 2000
- Requires Replacement of Metallized PET Blankets
 - Only Film Ignited with Electrical Arc
 - Significant Flame Spread
- Replacement Materials Must Meet Radiant Panel Fire Test Criteria
 - No Flame Spread Beyond Two Inches
 - No Flaming After Pilot Burner Removal
- Five Years to Complete (by June 30, 2005)

Final Rule

- Issued July 31, 2003
- Adopts New Fire Test Criteria for Insulation
 - Radiant Panel Test (In-Flight Fire)
 - Burnthrough Test (Postcrash Fire)
- Effective Dates:
 - Radiant Panel Test: September 2, 2005
 - Burnthrough Test: September 2, 2009
- Primarily Impacts Production Airplanes
 - Exception: Replacement Materials Must Meet Radiant Panel Test

Center Wing Tank Explosions



Thai International 737
March 3, 2001; Bangkok

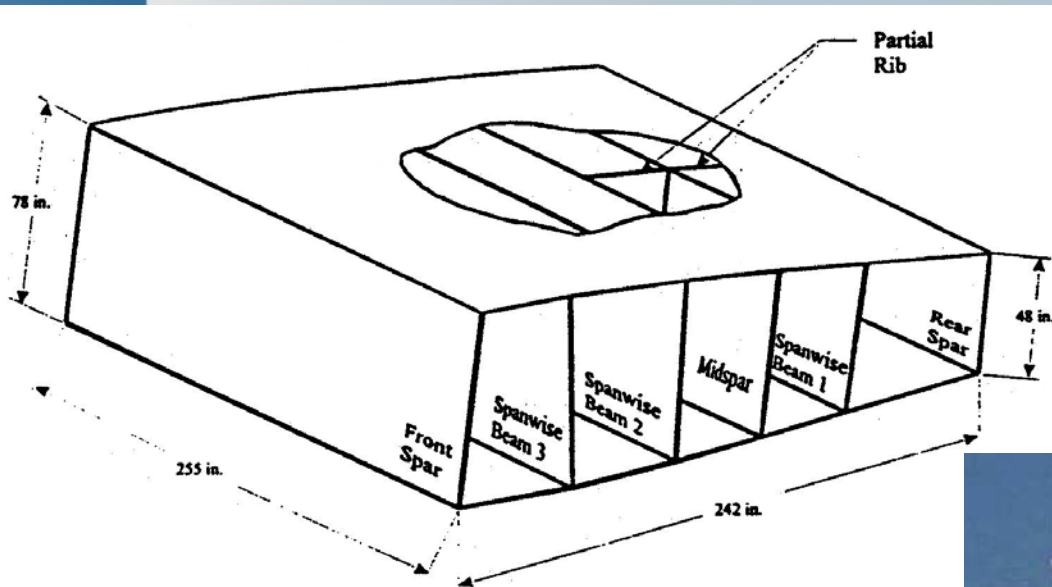


TWA 747
July 17, 1996; Off Long Island, NY



Philippine Airlines 737
May 11, 1990; Manilla

Fuel Tank Inerting System Development



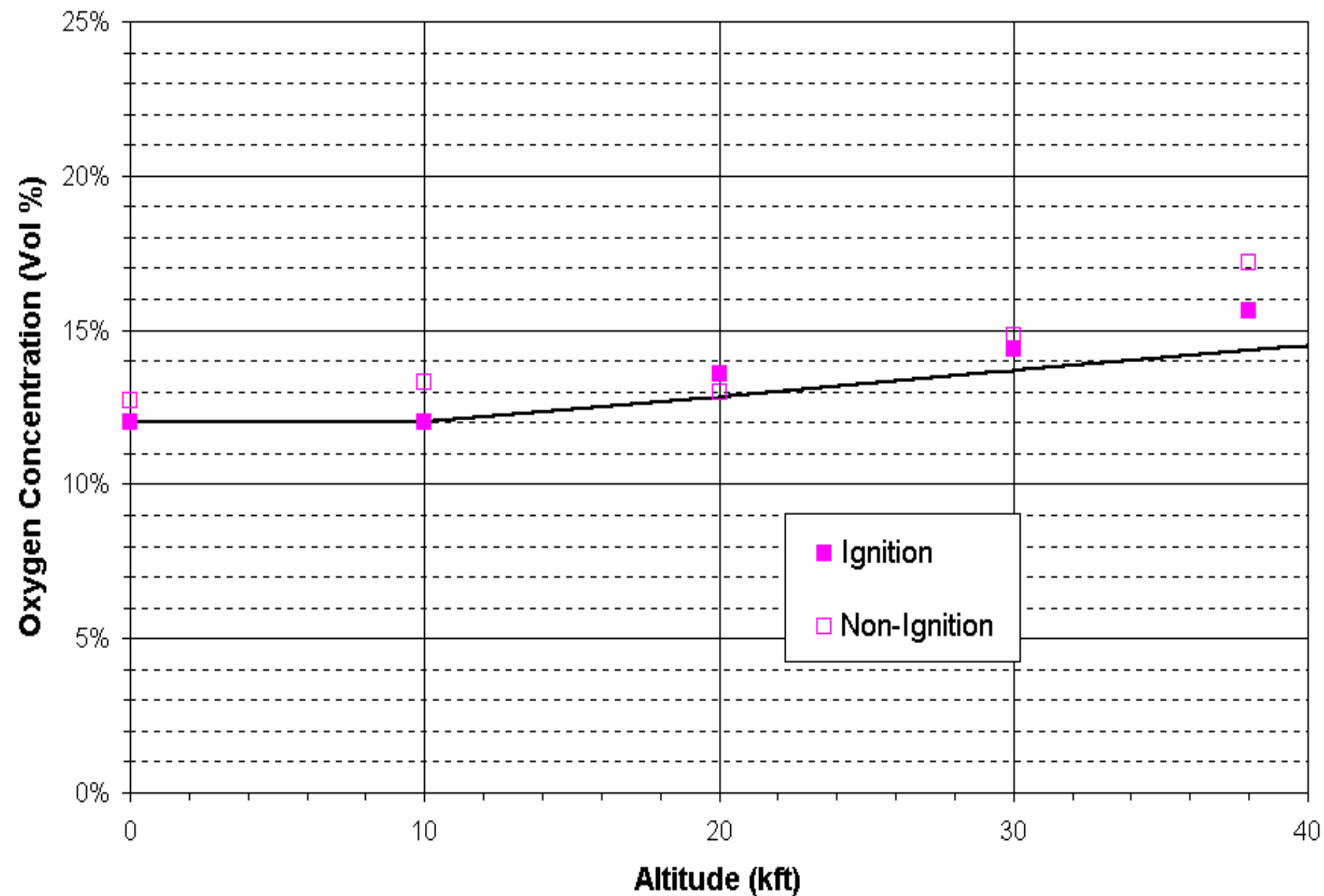
Inerting Requirements

- Ignition tests conducted at the FAA to determine the Limiting Oxygen Content (LOC)



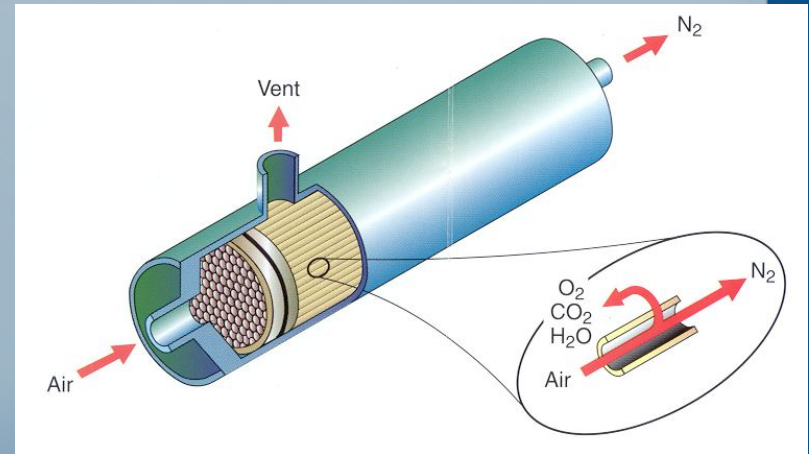
- **Controlled parameters:**
 - Pressure (altitude)
 - Fuel temperature/flammability
 - Oxygen concentration
 - Ignition source

Minimum/Maximum Values for Ignition/Non-Ignition

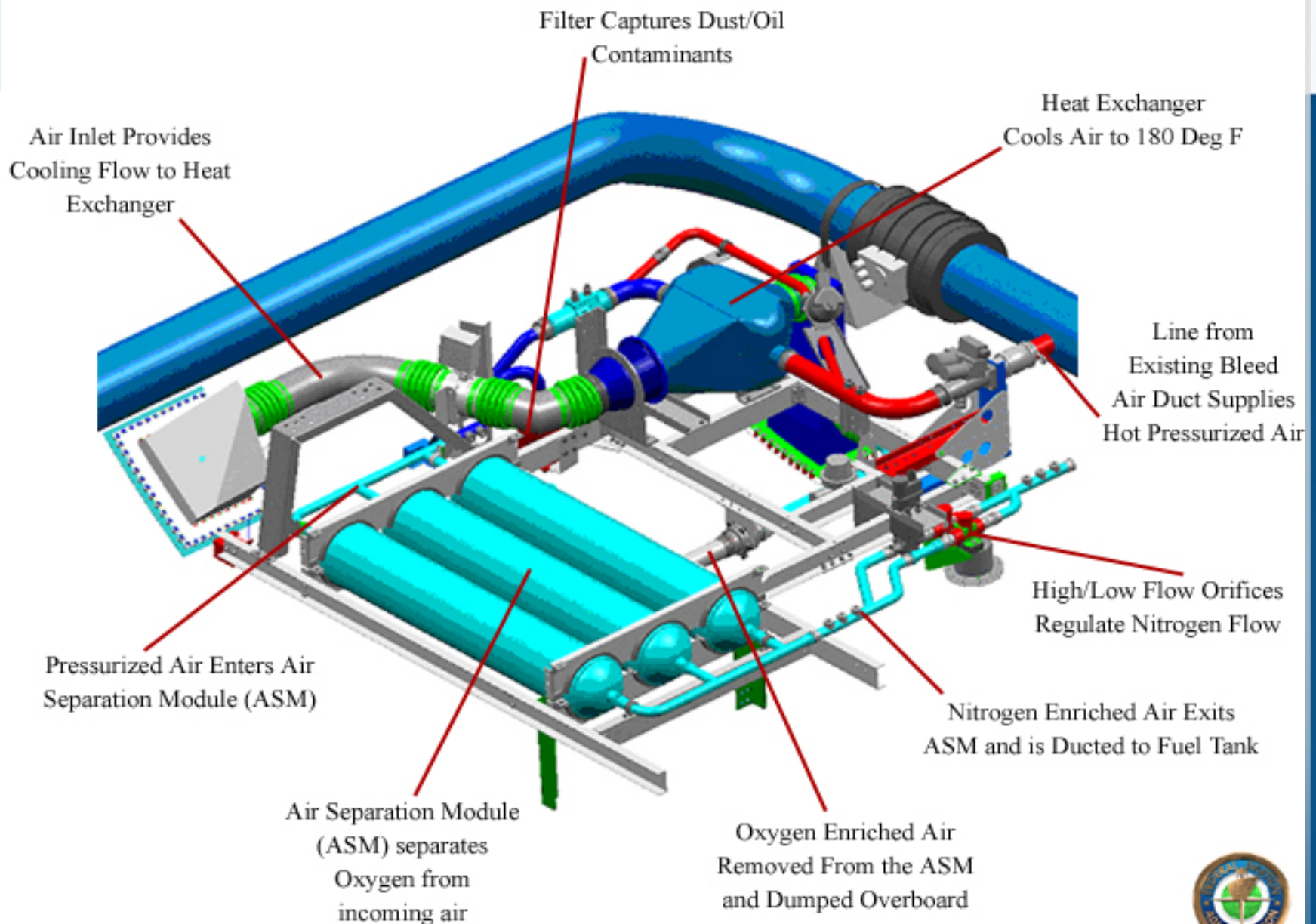


OBIGGS System Development

- Hollow fiber membrane technology uses the selective permeation properties of certain materials to separate air into two streams, one nitrogen rich and the other oxygen rich.
 - Materials are woven into hair-sized membranes and bundled by the thousands into a canister called an air separation module (ASM)
 - Pressurized air is forced through the membrane fibers, allowing fast gases to escape through the membrane wall and the nitrogen rich stream to pass through



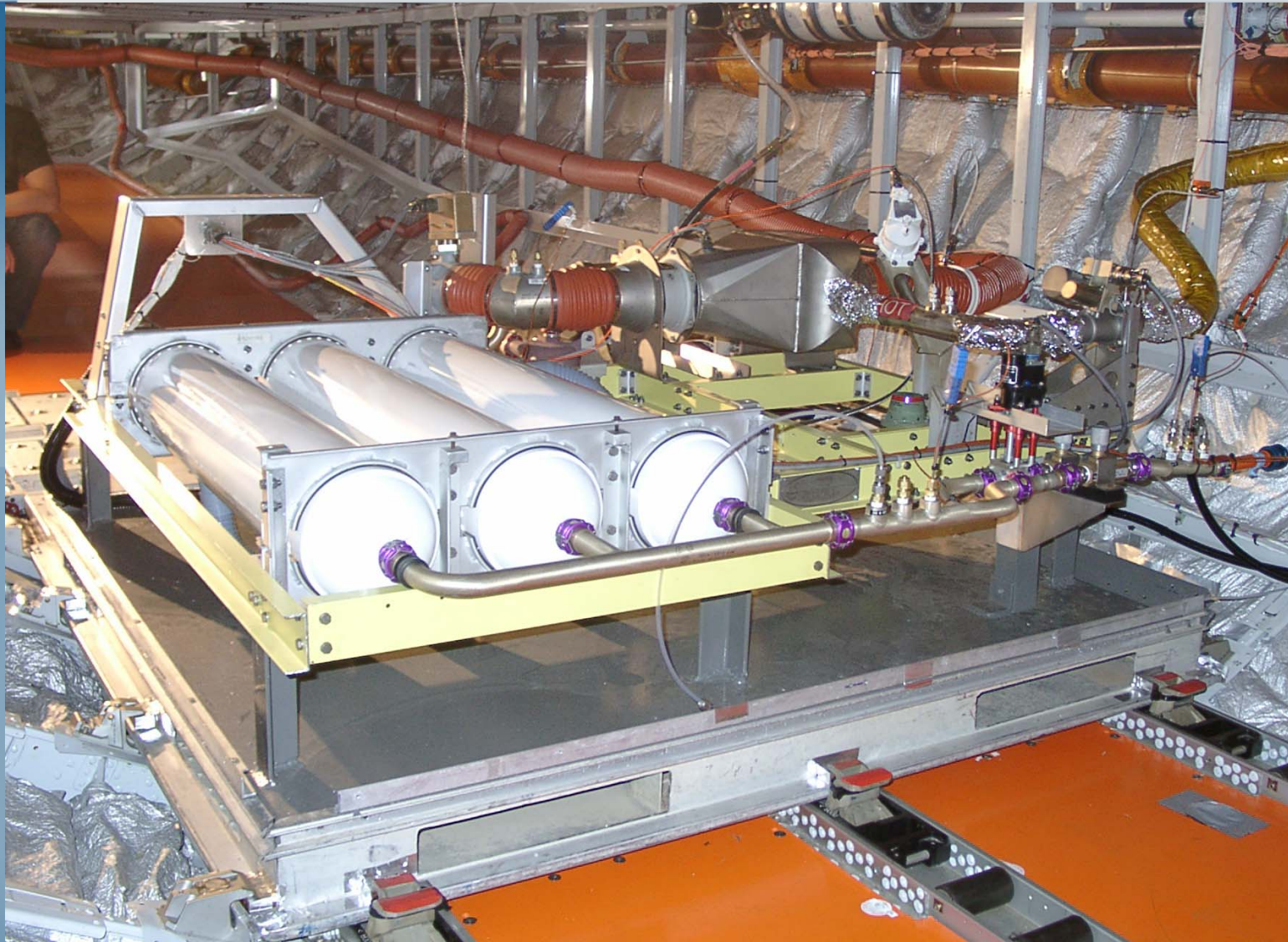
Schematic of On-Board Inert Gas Generation System (OBIGGS)



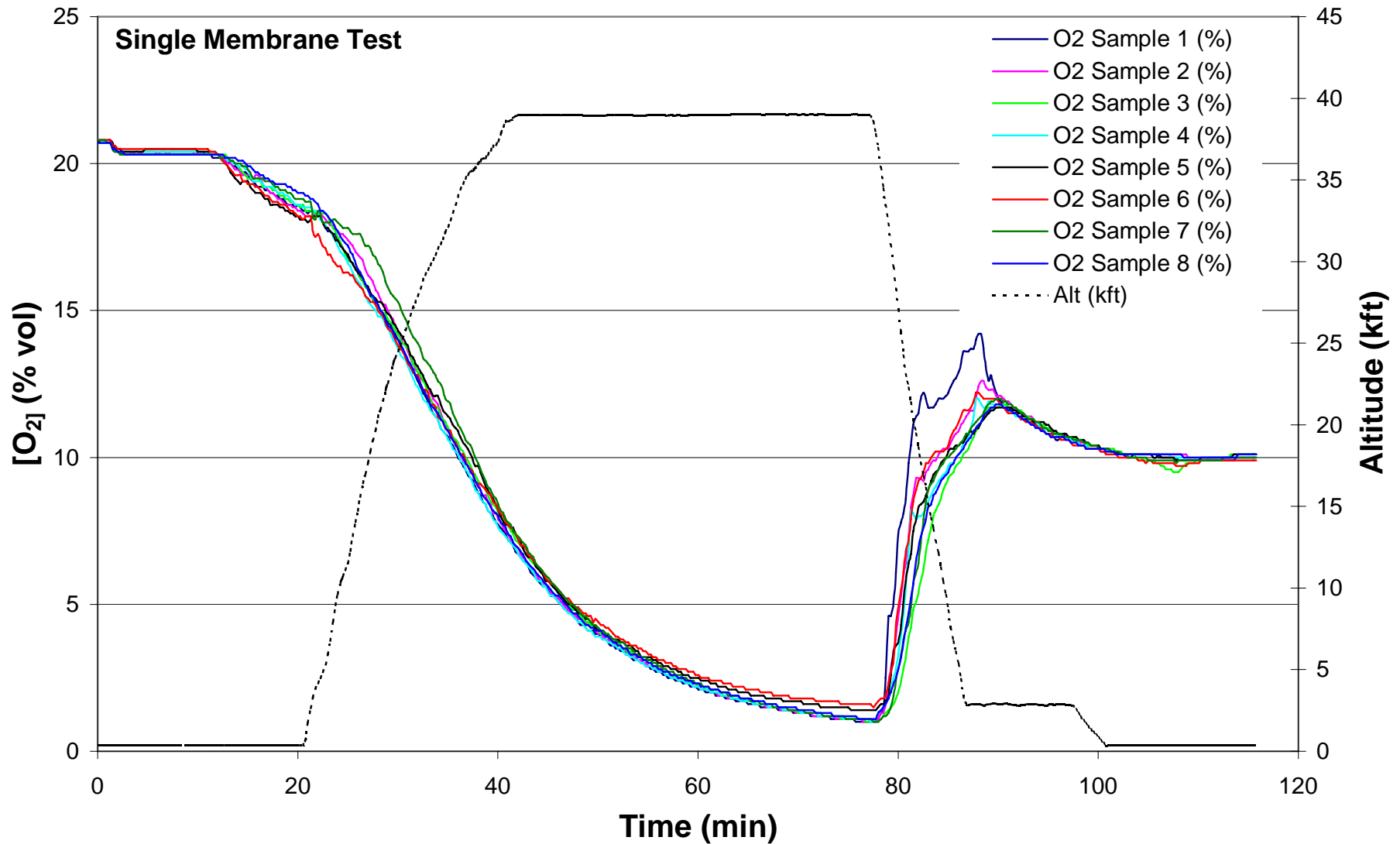
OBIGGS Installed in 747



OBIGGS Installed in 320



A320 Oxygen Data



Implementation of Fuel Tank Inerting

- Boeing Unilateral Decision to Install Inerting Systems in **Production** 737 and 747 Aircraft Beginning in 2005.
- On November 18, 2005 FAA Issued Notice of Proposed Rulemaking (NPRM)
 - Impacts In-Service Boeing and Airbus Aircraft with Heated Center Wing Tanks
 - Over 3200 Aircraft would be Affected
 - Impacts Newly Manufactured Aircraft

Recent & Current Activities

- Fire Test Methods for Wiring and Ducting
- Hidden Fire Extinguishment
- Fuel Tank Flammability
- Fire Safety of Structural Composites
- Halon Replacement in Engines & Cargo Compartments
- Cargo Fire Detection
- Oxygen Cylinder Protection
- Lithium Battery Fire Hazards
- Research Supporting the Development of Ultra-Fire Resistant Materials



[Fire & Cabin Safety](#) [Materials](#) [Systems](#) [Fire Research](#) [Reports](#) [Handbook](#) [Meetings](#) [Conference](#)

The Fifth Triennial International Fire & Cabin Safety Research Conference Call for Papers (updated 01/26/07)

Search

Go

Powered by
Google

What's New

Date	Section	Description
02/21/07	Materials	Updated March meeting agenda .
02/16/07	Materials	Added March meeting agenda .
02/16/07	Systems	Added April meeting agenda .
02/13/07	Conference	Online conference registration now open.
02/08/07	Systems: Fuel Tank Protection: FTFAM	Latest version of the FTFAM available.
01/29/07	Conference	Added information for the 2007 International Fire & Cabin Safety Research Conference.
01/26/07	Handbook	Updated Appendix F .
01/24/07	Systems	Added April meeting information & online meeting registration opens.
01/24/07	Materials	Added March meeting information & online meeting registration opens.
01/10/07	Systems: Fuel Tank Protection: Papers	Added paper OBIGGS for Fighter Aircraft .
01/09/07	Materials	Presentations and attendee list now available from Dec. meeting.
11/09/06	Handbook	Updated Chapter 8 .
11/03/06	Systems	Presentations and attendee list now available from Oct. meeting.
11/01/06	Materials	Added Dec. meeting agenda .
10/03/06	Materials	Added Dec. meeting information & online meeting registration opens.
10/02/06	Handbook	Updated Appendix F.

Announcements

Statement on the [Use of Magnesium in Airplane Cabins](#)

Modified and updated chapters 6, 7, & 15 of the Materials Fire Test Handbook as per FAA Policy Letter located at the top of the [Handbook](#) page.

The [Fifth Triennial International Fire & Cabin Safety Research Conference](#) will be held in Atlantic City, NJ, Oct. 29 through Nov. 1, 2007 at the Tropicana Casino Resort.

Highlights

- [2005 Highlights](#)
- [2004 Highlights](#)
- [2003 Highlights](#)
- [1999 Highlights](#)
- [1998 Highlights](#)
- [1997 Highlights](#)

Just Released

Amendment to Fire Penetration Resistance of Thermal/Acoustic Insulation Installed on Transport Category Airplanes

Datasheet for Round Robin for the Heat Release Test (OSU) and Smoke Density Test (NBS)

Burnthrough guidance material.

Information available for use in proposing methods of compliance with § 25.856(b)

Proposed rule for Fuel Tank Flammability published.

U.S. DOT/FAA - Reduction of Fuel Tank Flammability in Transport Category Airplanes